Response Of Broiler Chick To Diets Containing Vitamin C During Summer Season

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ABSTRACT

The experiment was conducted to evaluate the efficacy of supplemental ascorbic acid (AA) on the growth performance, antibody titer, carcass quality, and oxidative stability of carcass fat of broiler chickens reared under heat stress. A total of 30-day-old broiler chicks were distributed in three experimental groups fed diets supplemented with 0, 300 mg, and 600 mg/kg AA for a period from 13 to 45 days of age. Growth performance and antibody titer against Newcastle disease (ND) virus were determined. Blood samples were taken at the time of slaughter to investigate liver and kidney functions. Carcass quality, fat stability, and the economical efficiency were investigated. The performance data revealed higher weight gains in the experimental period for the supplemental groups as compared with control. Antibody production against ND virus was also improved; carcass characters were not influenced, the antioxidative status was reflected in decreased thiobarbituric acid reacting substances in tissue and liver of ascorbic acid supplemented chickens. Economically, diet supplementation with vitamin C at 300 mg had the most profits in relation to the diet costs and at 600 mg level in relation to the oxidative stability of the meat and the reduction of the stress induced by high temperature in comparison with the control group. It can be concluded from the above study that supplementation of AA at 300 mg or 600 mg/kg diet is beneficial for improving the performance and immunity of broiler chicks during summer season.

INTRODUCTION

In the 65 years since its discovery, vitamin C has come to be known as a "wonder worker." It's easy to see why: In addition to its role in collagen formation and other life-sustaining functions, it serves as a key immune system nutrient and a potent free-radical fighter. This double-duty nutrient has been shown to prevent many illnesses, from everyday ailments such as the common cold to devastating diseases such as cancer. Vitamin C exerts a powerful antioxidant effect on biological water-soluble compartments and represents an outstanding antioxidant in plasma; it reacts directly with superoxide anion (O_2), hydroxyl radical (OH) and various lipid hydroperoxides *(1-3)*. There is substantial evidence to suggest that under field and laboratory situations, treating poultry with AA may enhance productivity, immune response, disease resistance, and survivability under stressful conditions *(4- 9)*. Avian species have been reported to be able to synthesize AA *(10)*, thus supplementation of AA is generally considered unnecessary. However, environmental insults cause a marked increase in AA requirements, and birds are not able to synthesize sufficient AA to replace the severe losses of this vitamin during stress *(11)*. Therefore, supplemental AA may aid in overcoming any deficiency and enhance tolerance to stresses, concomitantly. Heat stress is one of the most important factors adversely affecting overall poultry production in the tropics. In Egypt temperature remains well beyond the higher side of thermo-neutral zone for the greater part of the year and adverse effects of heat make poultry production a difficult and uneconomical pursuit *(12)*. The domestic fowl is a homeotherm which can live comfortably only in a relatively narrow zone of thermo-neutrality extending from 14.5 to 25.5 °C *(13)*. Any deviation especially on the higher side depresses both the survival and the production. It is generally agreed that heat stress reduces the body weight *(14)*, immune response *(15)* and also causes mortality *(16)*. Different therapeutic measures are used to minimize the harmful effects of heat stress on performance of broiler chicks, e.g. AA *(17)*, B-Complex *(18)*, vitamin E *(19)*, acetylsalicylic acid *(20)*,

sodium chloride *(21),* potassium chloride, potassium carbonate, ammonium chloride *(22)* and sodium bicarbonate *(23)* etc.

The objective of this study was to determine the effect of supplemental dietary vitamin C provided throughout summer season for broiler chicks on growth performance, immune response, liver and kidney functions, some blood metabolites, carcass quality, oxidative stability of carcass lipids and the economical evaluation.

MATERIAL AND METHODS

1- Birds, housing and management

A total of 30-one-day broiler chicks of the Hubbard strain (300 g ± 11g in weight) were randomly allotted into three groups, (10 chicks each group). The birds reared on a deep litter system. The experiment was conducted between August and September with the room temperature ranged from 32°C to 36°C and relative humidity ranged from 65% to 75%. The different groups were accommodated in separate pens and maintained under good ventilation and continuous lighting program. Feed and water were offered free choice and the birds were fed a common starter diet for 12 days then assigned to the experimental diets at the age of 13 days. All birds were systematically vaccinated according to the sanitary programs for this category and coccidiostats was applied in the prophylactic dose.

2- Diets

The diet (Table 1) was formulated from corn, soybean meal and broilers concentrate. Deficient nutrients were supplemented using DL-Methionine, lysine, dicalcium phosphate. Energy was augmented by adding oil. The diet was mixed to contain 23.0% protein and 3200 kcal ME / kg and fed allover the experimental period. Also 1% mineral-vitamin premix was added to ensure the richness of the diet and to increase the safety margins recommended. The first group was served as a control and fed the formulated diet, whereas the diet of other treatments was supplemented with Ascorbic acid (B. P 93, from Elnasr pharmaceutical chemicals Co. Abu Zaabal, Egypt) 300 mg and 600 mg / kg diet, respectively.

Table 1. The composition of the experimental diets

Feed ingredients	%
Ground yellow corn	50. 338
Soybean meal (solvent-extracted, 44% CP)	30.730
Broiler concentrate (51.98% CP)*	10.00
Oil (7500 kcal/kg)	6.932
Mineral-vitamin premix**	1.00
DL. Methionine	0.04
Dicalcium phosphate	0.96
Total	**100.00**
Calculated energy and nutrients	
Crude protein %	23.0
Metabolizable energy (kcal/ kg diet)	3200
Methionine %	0.46+0.04(supp.)
Lysine %	1.24
Calcium %	1.06
Available phosphorus %	0.536

* Composition: Meat and bone meal 45%, corn gluten 60%, meat and bone meal 50%, fish meal 65%, Soybean meal 44%, salt, limestone, dicalcium phosphate, vitamin premix, mineral premix + choline, DL –methionine, and L-lysine hydrochloride. Company of Soya Egypt for feed production, portion 191 pelpeis road, 10th Ramadan city East Governorate (reg. No. 7164, Ministry of agriculture), Egypt. ** Each 3 kg contain: Vitamin A = 12,000,000 IU, D3 = 2,200,000 IU, E = 10,000 mg, K3 = 2,000 mg, B1 = 1,000 mg, B2 = 5,000 mg, B6 = 1,500 mg, B12 = 10 mg, Niacin = 30,000 mg, Biotin = 50 mg, Folic acid = 1,000 mg, Pantothenic acid = 10,000 mg, Zinc = 50,000 mg, Manganese = 60,000 mg, Iron = 30,000 mg, Copper = 4,000 mg, Iodine = 1,000 mg, Selenium = 100 mg, Cobalt = 100 mg, Calcium carbonate to 3 kg. Purchased by Multivita for animal nutrition, 6th October City, Egypt, registered by Adisseo Company, France.

3- Experimental procedure

a.Feed consumption was recorded for each treatment. Live body weight in grams was measured for all birds at the beginning of the experiment and then weekly.

b. Measurements of some blood constituents

By the end of the experiment blood samples were collected during slaughtering to separate the serum for the quantitative determination of aspartate transaminase (AST)

and alanine transaminase (ALT) *(24)*, total protein *(25)*, albumin *(26)*, total cholesterol *(27)*, and uric acid *(28)* and total creatinine *(29)*. The serum was also used for determination of glucose *(30)* and triglycerides *(31)*.

c.Determination of immune response

The immune response was evaluated by measuring the humeral immunity throughout heamagglutination inhibition (HI) test against Newcastle disease *(32)*. The results of HI titer of the sera samples were recorded and was given titer reference number (TRN) *(33)*, then they subjected to data analysis to calculate the geometric mean HI antibody titer. The weight of spleen, thymus and bursa of fabricuius were determined as they considered the immune responsible organs.

d.Carcass yield

At the end of the experiment (45 days of age) three representative birds from each test group were slaughtered after 12h fast for carcass yield measurements. The last includes the weight of slaughtered carcass, oven ready carcass or eviscerated carcass weight in which feathers; intestine, inner organs were removed in addition to the head, neck and feet. Edible organs and in special liver, heart, pancreas, gizzard and crop and lymphoid organs were also recorded.

e.Measuring lipid deterioration

Extraction of oil from meat and liver: At the end of the experiment, three birds were slaughtered. Thigh and breast muscles and liver were removed and frozen immediately at -20 °C. After 10 months of frozen storage, the meat and liver samples were thawed and then ground using meat mincer. The fat was extracted from the meat and liver according to the method of ***Folch (34)***. The extracted oil was used for the determination of:

1. ***Thiobarbituric acid reacting substances (TBARS)***

The method of ***Sedlacek (35)*** was applied. This analytical method is dependent upon the determination of liberated volatile aldehydes which formed during rancidity of oils employing the reaction of thiobarbituric acid (TBA) with these aldehydes, forming quantitative colored complex compound. The intensity of this color was measured photometrically and can be a useful guide to the degree of rancidity. So, TBARS value is used as a measure of the degree of oxidation. A higher TBARS value indicates a greater degree of oxidation of the meat.

2. ***Refractive index***

The refractive index was measured using Azeiss refractometer at 25 °C and the results were standardized at 40 °C *(36)*.

f.Financial cost

According to the guide lines of economic evaluation, the production costs include: chick price, feed cost, management care, and final body weight. The economical efficiency could be calculated from the input-output analysis based mainly upon the total feeding cost and the prevailing selling price of live body weight.

g.Statistical analysis

The data were subjected to ANOVA and t-test procedures. Statements of statistical significance were based on $P < 0.05$ according to **KaleidaGraph™** computer program *(37)*.

RESULTS AND DISCUSSION

1- Growth performance

Weight change and weight gain of broiler chicks fed the experimental during the experimental period (13-45 days of age) are presented in Tables 2 and 3. These results showed that weight gain of broiler chicks was insignificantly increased by addition of AA to the diet. Common stress factors in modern poultry production include high ambient temperature (AT) and relative humidity (RH), which often occur concurrently with other stress factors, especially during the hot-dry season *(38)*. The intensity and duration of the combined effects of AT and RH may vary with hours of the day and their actions on poultry have been shown to induce heat stress which adversely affects poultry production. Therefore, adequate evaluation and efficient prophylactics of its adverse effects may be

crucial to poultry productivity in hot-humid zones of the world. It is generally agreed that heat stress reduces the body weight *(14)*, immune response *(15)* and also causes mortality *(17)*. Since, kidneys which are the principal organs for chickens to synthesize AA, cannot synthesize adequate amounts of AA until after 15 d of age *(39)*. Therefore, kidneys of chickens at 21 d of age are functionally and morphologically competent to synthesize sufficient amounts of AA to supply the tissues to compensate any adverse effect on growth that otherwise might have been caused by vaccination.

The body requirement in AA during heat stress in poultry is greater than the amount synthesized by normal tissues; and its administration to broilers during heat stress has been shown to be beneficial to the body and improved weight gain and feed efficiency in broiler chickens during the hot dry season *(40,41)*. In Egypt, temperature remains well beyond the higher side of thermo-neutral zone in June, July and August and the adverse effects of heat make poultry production a difficult and uneconomical pursuit *(12)*. Any deviation of the thermo-neutral zone (14.5-25.5°C), especially on the higher side depresses both the survival and the production. The results in this study indicated that addition of AA during the growing period slightly increased final body weight and body gain for broiler chicks. This improvement may be attributed to first; AA stimulates growth through a direct effect on the cellular metabolism rather than indirectly by stimulating appetite *(42)*. Second; AA participates in the formation of deoxyribonucleic acid in the cell nucleus, so it may stimulate cell division and growth regeneration and restoration of body tissues *(43)*. Third; AA is involved in growth by promoting collagen synthesis, calcium and vitamin D_3 metabolism, carnitine synthesis for oxidation of fatty acids, oxidation of amino acids, electron transport in the cells, and scavenging of free radicals *(44)*. This finding is compatible with a previous report that chickens benefited from dietary supplementation of AA and gained weight faster than controls *(45)*.

Table 2. Means ± Standard error (SE) of live body weight change in gram/ chick

Age (days)	The experimental groups		
	Control	300 mg AA	600 mg AA
13	304±4.0 a	304±4a	300±10.95a
20	636±18.3a	618±30.06a	620±17.89a
27	1040±24.5a	1024±21.35ab	992±23.3b
34	1460 ± 40a	1400± 54.77a	1410±33.16a
41	1844±21.3a	1820±60.3a	1792±34.4a
45	1944±56.3a	2022±64.68a	2028±44.5a

AA: Ascrobic acid

Table 3. Means ± Standard error (SE) of live body weight gain in gram/ chick

Age (days)	The experimental groups		
	Control	300 mg AA	600 mg AA
13 - 20	332±18.5	314±28.2	320±20.9
20 – 27	404±16	406±44	372±30.7
27 – 34	340±49	376±58.8	418±42.5
34 – 41	464±49	420±83.9	382±62
41 – 45	100±21.9	202±36.4	236±21.35
13 - 45	1640±52.5 a	1718±61.19 a	1728±42.2a

Results of feed conversion (Table 4) indicated that dietary supplementation of AA improved ($p<0.05$) feed conversion of broiler chicks. This improvement may be attributed to the higher body gain.

Table 4. The effect of different Vitamin C supplementation levels on broiler chick performance

Item	The experimental groups		
	Control	300 mg AA	600 mg AA
Total body weight gain (Kg)	1.640	1.718	1.728
Average daily feed intake (g)	101.9	101.9	101.9
Average daily weight gain for 32 days (g)	51.25	53.687	54.0
Feed conversion ratio[1]	1.988	1.898	1.887
Total energy intake (Kcal/day)[2]	326.08	326.08	326.08
Energy/kg body gain (Kcal)[3]	6362.54	6073.72	6038.52
Total protein intake (g/day)[4]	23.437	23.437	23.437
Protein/kg body gain (g)[5]	457.3	436.54	434.02

1. Feed conversion ratio = Average daily feed intake (g) / Average daily body weight gain (g).
2. Total energy intake (Kcal/day) = Daily feed intake (Kg) X ME per Kg diet.
3. Energy/kg body gain (Kcal) = Average daily energy intake (Kcal) X 1000 g / average daily body gain (g).
4. Total protein intake (g) = Daily feed intake (g) X protein%.
5. Protein / Kg body weight gain (g) = Average daily protein intake X 1000 g / average daily body gain (g)

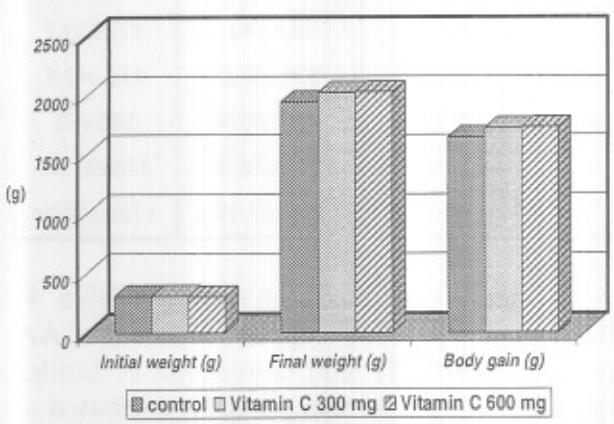

Fig. 1. Effect of AA supplementation on growth changes of different experimental groups of broiler chicks.

2- Immunization and lymphoid organs

The lymphatic tissues (spleen, thymus, and bursa of fabricius) have a considerable role in bird's immunity ***(46)***. The effect of AA on lymphoid organs and antibody titer are presented in Table 5. Results showed that the value of antibody titer increased significantly ($p<0.05$) by vitamin C supplementation to broilers diet compared to the control group. This improvement in antibody titer may be due to the high blood AA inhibited the biosynthesis and release of cortisone which is responsible for the immunosuppresion ***(5)***. Vitamin C increased the percentage of antibody synthesizing cells (plasma cells) ***(47)*** and activated the peripheral blood mononuclear cells to B and T lymphocyte mitogens ***(48)***. AA can modulate the activity of B cells, and addition of dietary ascorbate prior to immunization has been found to increase antibody production ***(49)***. Also AA scavenges oxygen–free radicals (i.e. by serving as an antioxidant). The antioxidant property of AA explains its ability to protect immature lymphocytes from damage of free radicals due to oxidation. Another possibility is that AA supplementation may speed up differentiation of lymphoid organs by increasing the activity of hexose monophosphate pathway, thus increasing circulating antibody ***(50)***.

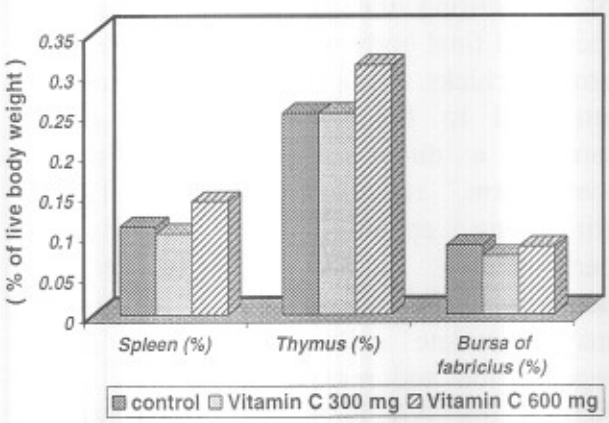

Fig. 2. Effect of different levels of AA on the weight of lymphoid organs.

Table 5. The effect of different levels of AA supplementation on immunization and lymphoid organs of broiler chicks.

Item	The experimental groups		
	Control	300 mg AA	600 mg AA
HI titer*	3.3±0.6a	16±1.15b	64±2.3c
Weight of lymphoid organs (% of live weight at slaughter)			
Spleen	0.109 ±0.02a	0.10 ±0.005a	0.14 ±0.02a
Thymus	0.25 ±0.046a	0.25 ±0.035a	0.31 ±0.08a
Bursa of fabricius	0.085 ±0.01a	0.072 ±0.00a	0.083 ±0.01a

**HI test with 8 HA units and 1% chickens RBC*

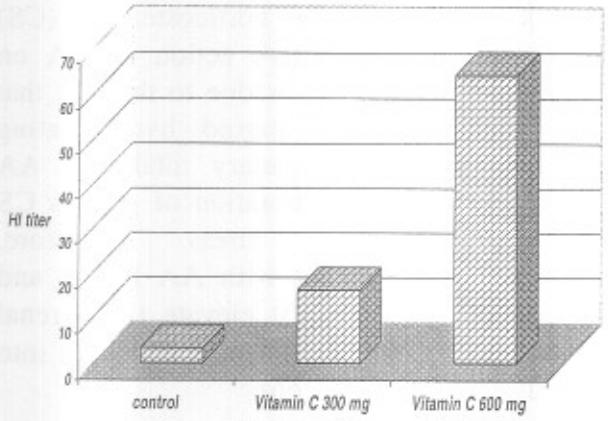

Fig. 3. Effect of AA supplementation on HI titer of different experimental groups.

Generally, extensive review *(5 and 51)* stated that AA has been demonstrated to improve immunoresponsiveness and increase disease resistance in chickens by optimizing the functions of the immune system. In the first line of defense against pathogens, phagocytosis by neutrophils involves increased consumption of both ascorbate and dehydroascorbate *(51,52)*. In addition, viral infections have been shown to cause depletion of leukocyte ascorbate, resulting in varying degrees of nonspecific immuno-suppression *(53)*.

3.The oxidative stability and quality of broiler meat

Poultry meat and meat products are susceptible to oxidative deterioration, and oxidation often determines the shelf life of poultry meat. The degree of oxidation of meat is generally assessed by measuring the content of primary oxidation [i.e., through the measurement of malondialdehyde, or cholesterol oxidation products (COP). The results TBARS and refractive index of previously frozen meat at -20 °C for about 10 months are shown in Table (6). Results revealed that an inverse relationship was observed between TBARS values and dietary AA concentration. Birds fed basal diet supplemented with 600 mg had significantly ($p<0.05$) lower breast and thigh tissue TBARS values and thus greater oxidative stability than samples taken from birds of other experimental groups. The TBARS values were lower by 4.58% to 41.2% for 300 and 600 mg AA supplementation, respectively. The results recorded with the TBARS values of fat extracted from liver samples showed insignificant decrease for high AA level in the diet. The results of this study indicated that the dietary AA concentration can influence the oxidative stability of muscle and liver of broiler chicks. Indeed, AA supplementation is controversial, because depending on the concentration, it can act either as an antioxidant or as a prooxidant in muscle foods *(54)*. Furthermore, low concentrations of AA in meat lead to prooxidant effects by reducing free-transition metals such as Fe (III) or Cu (II) to lower valence states [i.e., Fe (II) and Cu (I).], where by the catalyst is more active in decomposing lipid hydroperoxides to free radicals. In contrast, AA at high concentrations showed antioxidant effects due to its ability to scavenge oxygen and lipid free radicals ***(54,55)***. Thus, because AA and other antioxidants can have synergistic effects, oxidation susceptibility may be reduced as a result of its supplementation. In accordance with this, ***Aydemir (56)*** reported increased glutathione peroxidase activity and lowered oxidation in erythrocytes from chickens fed AA supplements.

Table 6. TBARS and refractive index of broiler tissue and liver fat of experimental groups.

Item	Experimental groups		
	Control	300 mg AA	600 mg AA
Tissue fat			
TBARS value	4.37 ±0.2a	4.17 ±0.3ac	2.57 ±0.15 b
Refractive index	1.3425 ±0.002a	1.3435 ± 0.0012a	1.3415 ± 0.0009a
Liver fat			
TBARS value	2.65 ±0.30 a	1.95 ±0.057 a	1.75 ±0.023 a
Refractive index	1.35448 ±0.0007a	1.35751 ± 0.002a	1.34337 ±0.009a

Also in heat stress, free radicals are generated in the body in such a large quantity that the natural antioxidant defense systems of the body are overwhelmed *(57,58).* This results in lipid peroxidation of cytomembranes; and, consequently, cell damage and destruction *(59-61).* According to ***Sen (62), Tauler (63) and Minka and Ayo (64),*** antioxidant supplementation may provide beneficial effects against stress-induced tissue damage.

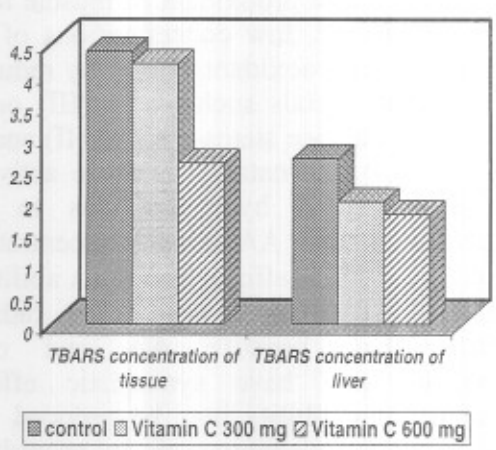

Fig. 4. Effect of different levels of vitamin C on TBARS concentrations of fat from muscle and liver of different experimental groups.

4. Serun constituents

Effects of diet supplementation of AA on some serum constituents of broiler chicks are shown in Table 7. The results showed that no significant effects ($p>0.05$) were detected for AA supplementation on liver enzymes (ALT and AST) and kidney function (creatinine and urea). On the other side vitamin C supplementation decreased cholesterol level significantly ($p<0.05$) compared to control group. This effect may be due to vitamin C as antioxidants protects high amount of unsaturated fatty acids from oxidation which may stimulate the cholesterol excretion into the intestine and the excretion of cholesterol to the bile acids. Review recorded that AA suppresses adrenocortical steroidogenesis and depresses the plasma corticosterone (CS) levels *(5).* The restrictive action of AA on adrenal steroidogenesis is due to the fact that AA inhibits adrenal steroid hydroxylating enzymes *(65).* High dietary intake of AA down-regulates the elaboration of plasma CS level during heat stress. Therefore, supplementing the diet with AA before and during heat stress might elevate the adrenal stores and prevent or delay CS depletion into the circulatory system *(66).*

The increase of CS due to low serum AA is responsible for increasing serum glucose level. Results explain the effect of AA in decreasing the CS and consequently decrease ($p<0.05$) serum glucose. This response is the result of an increased AA requirement during heat stress *(11).* Generally, vitamin C dietary supplementation had no adverse effects on liver and kidney functions, had significantly increased serum protein (total protein, albumin, globulin and A/G ratio) and had decreased significantly serum cholesterol, numerically as compared to control group.

Table 7. Effect of vitamin C levels on some serum constituents of broiler chicks

Item	Unit	Experimental groups		
		Control	300mg AA	600mg AA
Liver function				
Total protein	g/dL	2.3 ± 0.17a	2.7 ±0.17ab	3.2 ±0.23b
Albumin	g/dL	1.2 ± 0.17 a	0.5 ± 0.11b	0.6 ±0.12bc
Globulin	g/dL	1.1 ± 0.11a	2.2 ± 0.23b	2.6 ±0.1 b
A\G ratio		1.1 ± 0.14a	0.2 ± 0.02b	0.2 ± 0.02b
ALT	U/L	4.8 ± 0.9a	3.21 ± 0.13a	3.2 ± 0.25a
AST	U/L	13.0 ± 0.0 a	13.0 ± 1.79a	13.0 ± 1.67a
Glucose	mg/dL	255 ± 2.04 a	250 ±3.46b	250 ± 4.6b
Lipid fractions				
Cholesterol	mg/dL	118 ± 2.88a	100 ± 1.15b	88 ±1.7 c
Triglycerides	mg/dL	103.45 ±2.0a	103 ± 1.38a	96.6 ± 1.09b
Kidney function				
Creatinine	mg/dL	0.10 ±0.005a	0.10 ±0.006a	0.10 ±0.011a
Uric acid	mg/dL	3.6 ± 0.23a	3.4 ± 0.17a	4.1 ±0.23a

5. Carcass characters

Data present in Table 8 showed that broilers fed diets supplemented with vitamin C showed non significant effects of carcass parameters compared to the control group.

Table 8. The effect of different levels of vitamin C supplementation on carcass yield of broiler chicks

Item	Experimental groups		
	Control	300 mg AA	600 mg AA
Average live weight at slaughter (g)	1944 ± 56.3 a	2022 ± 64.68a	2028 ±44.5a
Items as % of live body weight			
Slaughtered carcass	86.16 ± 0.81a	85.3 ± 0.55ab	84.4 ± 0.6b
Oven ready carcass	71.21 ± 0.95a	70.4 ± 0.88a	71.62 ± 0.29a
Edible organs	2.92 ± 0.04 a	2.916 ± 0.006a	2.73 ± 0.18a
Liver	2.34 ±0.085a	2.34 ± 0.06a	2.09 ± 0.24a
Heart	0.466 ± 0.02a	0.466 ±0.07a	0.48 ± 0.1a
Gizzard and crop	2.69 ± 0.17a	2.36 ± 0.29a	2.57 ± 0.29a
Pancreas	0.208 ± 0.01a	0.176 ± 0.054a	0.22 ±0.006a
Intestinal length (cm)	163.67 ±1.3a	170.3 ±3.28a	160 ± 5.29a
Intestinal width (cm)	1.2 ±0.046a	1.16 ± 0.03a	1.15 ± 0.02a

6. Economical efficiency

The main purpose of this item of the study is to investigate the economical possibility of using vitamin C as feed supplement in broiler chick diets. Feed cost for broilers fed diet containing 300 and 600 mg AA were 6.33 and 6.46 LE /chick, being higher than that of the control group which was 6.2 L.E / chick (Table 9). On the other side, the net revenue value per chick of experimental group fed diet supplemented with 300 mg AA was higher than other groups due to the higher final live body weight and the relative economical efficiency of the diet was the highest. Such diet was recorded as the lowest feed cost needed to obtain one kg live body weight. On the other side, the improvement of the meat quality obtained by adding vitamin C was indicated, there being a significant reduction in losses due to discoloration, and decreasing the shelf life of chicken meat. This brings more profits for both the meat producer and trader. The

producer is able to supply meat of higher quality that should fetch a higher price, while the trader benefits from the smaller losses due to exudation and discoloration of the meat and is able to market a product of higher organoleptic and nutritional quality.

Table 9. Price list of different ingredients (1kg) used in the diet formulation (year 2006).

Diet ingredients and additives	Price (L.E. / kg)
Yellow corn	0.966
Soybean meal 44%	1.695
Concentrate mixture 52% protein	3.066
Dicalcium phosphate	3.33
Oil	4.00
Mineral-vitamin premix	7.33
DL-Methionine	24.00
Ascorbic acid (100g)	13
Price per chick at hatch	3.25
Management per chick	0.5
Selling price	8.5

Table 10. Economic evaluation of different experimental diets

Item	Experimental groups			
	Unit	Control	300 mg AA	600 mg AA
Final body weight	g	1944	2022	2028
Cost of diet/ ton	L.E.	1705.9	1744.9	1783.9
Price / chick at hatch	L.E.	3.25	3.25	3.25
Management / chick	L.E.	0.5	0.5	0.5
Feed cost up to 13 days	L.E.	0.64	0.64	0.64
Feed cost from 13-45 days	L.E.	5.56	5.69	5.82
Total feed cost /chick	L.E.	6.2	6.33	6.46
Total cost /chick	L.E.	9.95	10.08	10.21
Total revenue /chick	L.E.	16.5	17.19	17.24
Net revenue / chick	L.E.	6.574	7.107	7.028
Economic efficiency	L.E.	0.66	0.71	0.69
Relative economic efficiency	L.E.	0.00	1.07	1.04
Feed cost / kg body weight	L.E.	3.19	3.13	3.19

1. Total cost per chick = Total feed cost + Management of chick (L.E.) + chick price (at the start of the experiment, L.E.).
2. Total revenue per chick (L.E.) = Final body weight (Kg) X selling price of Kg chick live body weight (L.E.).
3. Net revenue per chick (L.E.) = Total revenue per chick (L.E.) – (Total costs per chick (L.E.).
4. Economic efficiency = Net revenue per chick (L.E.) / total costs per chick (L.E.).
5. Relative economic efficiency = Economic efficiency of each experimental group /economic efficiency of the control X 100.

Finally, it can be concluded that diet supplementation of AA for broiler chick has favorable effect on growth performance, antibody production; oxidative stability of meat and has no adverse effects on liver and kidney functions. From the nutritional and economical points of view: 600 mg AA is successful level under condition of this study especially in heat stress (32°C). Economically, Addition of AA in the diet was found to be beneficial due to the improvement in the broiler chick performance, immunity, and oxidative stability of the meat products.

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الملخص العربى

مدى استجابة كتاكيت التسمين للتغذية على علائق تحتوى على فيتامين ج فى فصل الصيف

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إجريت هذه التجربة الغذائية بكلية الطب البيطري بمشتهر وقد صممت هذه التجربة لتقيم تأثير استخدام إضافة فيتامين ج بمستوى (صفرو٣٠٠ و٦٠٠ ملليجم لكل كجم من العليقة على النمو وخواص الذبيحة والإستجابة المناعية ووظائف الكبد والكلى ودرجة ثبات الدهن ضد الأكسدة والتقييم الإقتصادى وقد اسستخدمت كتاكيت تسمين هبرد عمر١٣ يوم وتم تقسيمها بصورة عشوائية الى ثلاث معاملات الأولى غذيت على عليقة لم تزود بكميات اضافية من فيتامين ج كعليقة كنترول والمعاملتين الأخريين غذيت على عليقة الكنترول مضاف اليها ٣٠٠ و٦٠٠ ملليجم فيتامين ج لكل كجم من العليقة واستمرت التغذية لمدة ٣٢يوم وأوضحت النتائج المتحصل عليها على الأتى : كان هناك تأثير إجابى على النموواإستجابة المناعية ضد مرض النيوكاسل ودرجة ثبات الدهن ضد الأكسدة ومن الجانب الإقتصادى أدى اصافة فيتامين ج الى زيادة الناتج الربحى النهائى وعلى الجانب الاخر لم يكن هناك أى تاثير على خواص الذبيحة أو أى تأثير عكسى على وظائف الكبد والكلى وإنخفضت نسبة الكلسترول فى الدم وفى النهاية يمكن القول بأن اضافة فيتامين ج الى كتاكيت التسمين في فصل الصيف أدى إلى نتائج جيدة على التغذية و الرعاية وإقتصاديات التربية والإقلال من تأثير الإجهاد الحرارى.